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GLAUBERITE CRYSTAL CAVITIES IN THE TRIASSIC ROCKS IN THE VICINITY OF GETTYSBURG, PA.[1]

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Among the specimens of Triassic rocks collected during the survey of the Fairfield and Gettysburg quadrangles, Pennsylvania, for folio publication, certain dark shales and hardened altered shales with molds of crystals were obtained, and were sent with specimens of metamorphosed sediments and igneous rocks to Prof. J. Volney Lewis for petrographic study. In a letter dated May 24, 1915, Professor Lewis wrote:

> "The casts [molds] of crystals . . . suggest very strongly the mineral glauberite and my conception of the climatic conditions under which these sediments accumulated would make this mineral entirely possible, even probable, in the muds and 'alkali' marshes. I happen to have some crystals that almost exactly fit the cavities, conforming in size and shape."
>
> "I wish to add, as a matter of simple justice, that the first suggestion of glauberite as the original mineral of these cavities was made by Mr. W. S. Valiant, Curator of the Geological Museum of Rutgers College, who observed the striking resemblance while unpacking the specimens, or very soon afterward, before I began my studies of them. Later when I compared the molds and wax casts of some of them with crystals of glauberite, their essential identity was quickly established."

EXPLANATION OF FRONTISPIECE

Molds of glauberite crystals in Triassic shales from vicinity of Gettysburg and crystals of glauberite from San Bernardino County, Cal. Photographed by J. Volney Lewis. Natural scale.

No. 1. From locality 1 (see Fig. 1.); shows mold of rhombic face of crystal with characteristic parallel growth striations.

No. 2. From locality 1; shows molds of rhombic face of crystal and characteristic aggregates of crystals.

No. 3. From locality 2; shows wedge-shaped (or lozenge-shaped) cross sections of cavities.

Nos. 4, 5, 6. Crystals of glauberite from San Bernardino County, Cal. Nos. 4 and 5 show the rhombic faces that correspond to the impressions in Nos. 1 and 2, and No. 6 shows aggregates of crystals which correspond to the molds in No. 3.

[1] Published by permission of the Director of the U. S. Geological Survey.

This was the first intimation I had of the significance of these cavities. Since then two articles by Dr. Edgar T. Wherry[2] have been published in which the mineral which formed similar

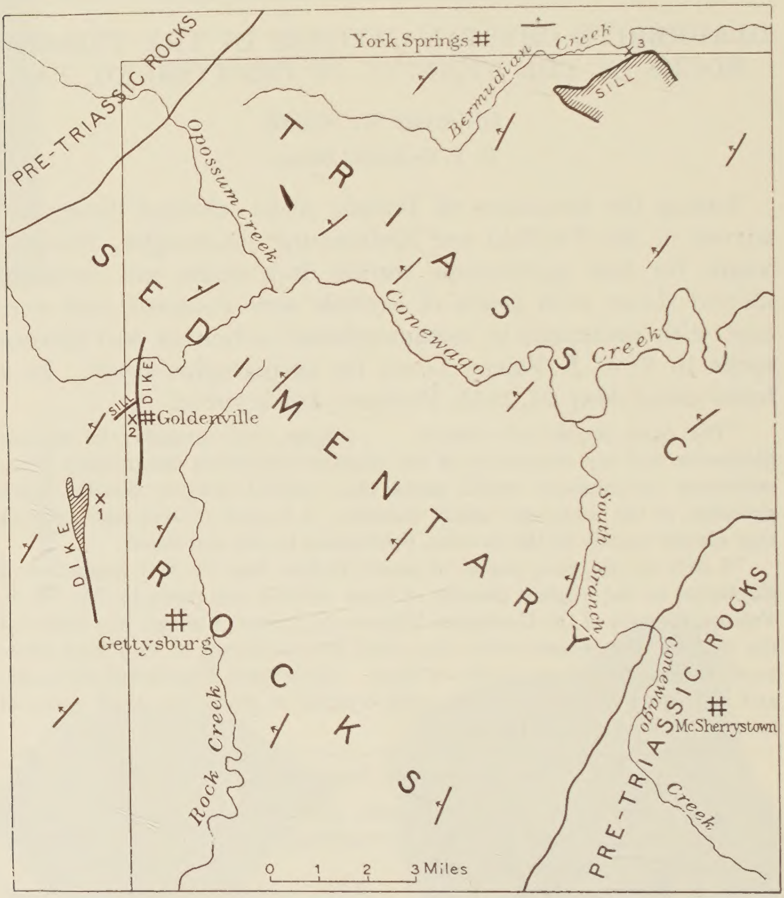

FIG. 1. Sketch map of the Gettysburg quadrangle, Pa., and immediately adjoining area on the west and north, showing localities where molds of glauberite crystals were obtained and adjacent diabase sills and dikes. The direction of dip of the Triassic rocks is shown by arrows. Locality 1. 3 miles northwest of Gettysburg. Best specimens; rock little altered. Loc. 2. 4½ miles north of Gettysburg, just west of Goldenville. Good specimen; rock hardened. Loc. 3. North edge of the Gettysburg quadrangle, 3 miles east of York Springs. Rock much altered.

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[2] The lozenge-shaped cavities in the First Watchung Mountain zeolite deposits; *J. Wash. Acad. Sci.*, **6**, 181–184, 1916. Glauberite crystal cavities in the Triassic rocks of eastern Pennsylvania; *Am. Min.*, **1**, 37–43, 1916.

molds, in the Triassic rocks at several localities lying 100 miles or more further east, is shown to be glauberite.

In the Gettysburg quadrangle and adjoining areas specimens of the crystal cavities were obtained at three places, shown on the sketch map herewith, Fig. 1. The holes which compare most favorably with crystals of glauberite in the possession of Professor Lewis were photographed by him and are presented in the frontispiece. The fact that the glauberite crystals and the molds in this photograph are almost identical in shape and size supports the conclusion presented by Dr. Wherry in his papers referred to above.

Glauberite is a sodium-calcium sulfate, $Na_2Ca(SO_4)_2$, found in nature in rock salt deposits and on alkali flats in various parts of the world. It is evidently the product of slow desiccation of alkaline water in arid regions. The occurrence of this mineral in the Triassic sediments is probably to be explained, therefore, by deposition under similar climatic conditions, *i. e.*, in ponded water in an arid climate (playa basins).

The Triassic sediments of the Gettysburg district, which is part of a belt that extends from New York to Virginia, are believed to have been deposited in an elongated continental basin into which streams from the adjacent highlands to the east brought an abundance of rock waste. The climate was arid and the rains were accordingly spasmodic and torrential, so that flooding of the basin by the streams during times of torrential rains in the mountains alternated with times of drought and evaporation of the ponded water. The coarser sands and arkoses were largely deposited as thin sheets of alluvium in flat, wide-spreading, coalescing alluvial fans by the flood waters as they first spread out over the lowland plain, whereas the finer sediments were in large part laid down in ponded water after the inflow had ceased. Nearly all the beds, therefore, have a normal sedimentary habit. Numerous ripple marks, animal trails, rain prints, rills, and sun cracks on the surfaces of the beds bear evidence of frequent drying up of the lakes and exposure of the freshly deposited sediments in mud flats. The prevailing warm arid climate is indicated by the red color of most of the sediments, the rocks on the higher land having been deeply weathered and thoroly oxidized before being washed into the basin. There was not sufficient organic matter deposited with these red sediments to transform the brilliantly colored ferric oxide to the dull gray ferrous carbonate. During the droughts, when the standing water was entirely or nearly evaporated, the dissolved salts were concentrated to the point of saturation, and crystals of the minerals in solution were formed on the shores and possibly on the bottom of the ponds, which at such times were probably reduced to alkali swamps or even to dry encrusted playa flats. Glauberite and perhaps other allied minerals crystallized out, altho molds of salt crystals have not been observed in this region. The crystals that were formed in the saturated muds, and others that were quickly covered by sediment during the next influx of water into the basin, became inclosed in the sands and clays and preserved in the strata.

The fact that in at least two and possibly all three occurrences in the Gettysburg area the rocks which contain the molds are somewhat altered and hardened by the action of heated waters given off from the dikes or sills of diabase, whose proximity to the localities where the cavities were found is shown in figure 1, may perhaps be regarded as indicating that the glauberite crystals were still present in these clays and sands at the time when the igneous rocks intruded them and the sediments were hardened around the crystals, so that when they were subsequently dissolved by circulating waters their molds were preserved sharp and clear, as shown in the photographs (frontispiece).

It is probable, therefore, that glauberite crystallized out of ponded waters at various times during the Triassic epoch; and the crystals were inclosed at many horizons thruout the Triassic section, altho thus far clearly defined molds of the mineral have been found in this area only in beds which have been somewhat hardened by the metamorphic action of the intrusive diabase.

BARITE FROM GREAT NOTCH, N. J. Ernest H. Wilson. *Caldwell, N. J.*—Some years ago the writer obtained at the Great Notch trap quarry a 5 x 10 cm. specimen showing an aggregate of small crystals of a dull white color, on a fragment of trap rock. This has recently been submitted to Mr. H. P. Whitlock, of the American Museum of Natural History, who has identified it by blowpipe tests as barite. Altho this mineral is not infrequently associated with trap rocks, and has been found under such circumstances at several other localities in New Jersey, this appears to be the first report of it from this place. At one end of the specimen are a number of very small calcite crystals and a couple of globular crystals of prehnite, but the barite rests directly upon the trap, suggesting that it was one of the earliest minerals to form.

FAMOUS MINERAL LOCALITIES: THE DATOLITE LOCALITY NEAR WESTFIELD, MASSACHUSETTS

EARL V. SHANNON
Springfield, Mass.

The beautiful crystallized datolite specimens which are found in all collections labeled "Westfield, Mass.," have come from the Lane quarries, midway between Springfield and Westfield. These quarries, which are three in number, are located in the Middle or Holyoke trap sheet which forms a long narrow elevation locally known as the Holyoke "Range." The locality is best reached from the Springfield-Westfield trolley line by way of the road which runs north past the State Sanitarium, the northernmost quarry being a little over a mile from the trolley line. The writer recently visited this locality and was able, with a little search, to obtain a number of specimens of very fine datolite. This locality is easily accessible and should, at any time, amply repay any one of mineralogical bent who spends a few hours seeking specimens.

The trap rock, which is quarried and crushed for road metal, etc., is a typical diabase of fine to medium grain. In the hand specimen the rock is rather dense and greenish-gray and, on fresh fracture, appears but little altered. It is everywhere divided into small blocks, partly by original cooling cracks but largely by fractures probably chiefly due to straining and fissuring under comparatively light overload. Indeed so thoroly intersected is the rock by close spaced joints that crushed stone is the only possible product of the quarries, as blocks large enough for building or even paving could scarcely be obtained. Quarrying is, as a consequence, a rather simple operation, a few widely-spaced drill holes at the bottom of the cliff face serving, when blasted, to bring down a great slice of the diabase in blocks small enough for the steam shovels to conveniently handle.

The trap in each of the three quarries is traversed by one or more well-defined shear zones from one to five feet in width and composed of greatly crushed, slickensided and altered fragments of diabase more or less veined and cemented by secondary minerals. In these zones are many white veins and stringers composed in the main of calcite and datolite. The first mineral deposited has in most cases been calcite but in some places there is a layer of a carbonate which weathers to a brown color and is probably ankerite, followed by calcite in broad cleavage surfaces which, in turn, is followed by transparent pale green crystalline-granular datolite. In very few cases has there been sufficient open space in the shear zone itself to permit the formation of free crystal surfaces of datolite of any great size but these fissures have been the means of access for the mineralizing solutions and where these solutions have spread outward from the fissures and have found open spaces between the displaced blocks of trap, numbers of large datolite crystals have formed. Judging from the abundance of datolite fragments in the fine debris on the floor of the quarries, datolite must have been common and widely distributed in the trap. In the first, or southernmost, quarry only massive and imperfectly crystalline datolite was seen and this was confined to the zones of shearing where it was associated with fine to coarse granular calcite which, in places, contained a little pyrite and, in one place, cleavable yellow-green sphalerite. In another place, not directly associated with the datolite, a cavity in trap was lined with pale amethystine quartz crystals. The best datolite obtained by the writer was found in the middle quarry. Here there are at least three shear zones in which the trap is much crushed, bleached and serpentinized. In all of these calcite, in veinlets with small rhombohedral crystals, and crystalline-granular datolite are abundant. The best datolite was in a pocket between unaltered altho slickensided blocks of trap some thirty feet from the nearest shear zone. There was no external indication of this cavity, which was discovered quite by accident when a block of the trap was loosened. The hollow polygonal cavity contained some fifty pounds of fine transparent yellow-green datolite crystals. The only other mineral present was coarse-crystalline translucent calcite which, in part, occupied the center of the vug. The datolite crystals, when removed, left perfect molds in the calcite.

In the northernmost quarry, which is the largest, a wide shear zone is intimately traversed by a stockwork of veinlets of calcite and datolite, the latter being the most abundant. The calcite is, in part, crystallized in steep rhombohedral and scalenohedral forms. All of the datolite seen here was more or less friable due to movement along the fissure. Most of the datolite veins have a core of second generation calcite and the last deposit in one open space was a layer of bluish translucent chalcedony one eighth to one fourth inch thick.

EDITORIAL

The beginning of a new volume is an appropriate point at which to review past achievements and announce future plans. A brief outline of the history of the magazine will be given first. The first number appeared in July, 1916, and sample copies of it, as well as of the two succeeding ones, were distributed to everyone interested in mineralogy known to the editors. Enough subscriptions were soon received to guarantee the preliminary success of the enterprise, altho the close of the first volume, in December, 1916, found us with a considerable deficit on our hands. This was met by generous contributions from our friends and loans from some members of the editorial board.

The project of publishing the magazine having originated with the Philadelphia Mineralogical Society, three of its members were appointed, two as editors, and the third as business manager. Other mineralogical organizations were invited to appoint representatives, and the New York Mineralogical Club and the Mineral Collectors' Association designated their secretaries to act as editors. Mr. Wallace Goold Levison of the New York Club, being the senior member of the board of editors, was appointed by them editor-in-chief, but as he was unable to give much time to the magazine's affairs, Dr. Edgar T. Wherry acted as managing editor practically from the start, and has been responsible for the bulk of the editorial work. Mr. Samuel G. Gordon has looked after the obtaining of subscribers and advertisers, the mailing of the magazine, and the carrying on of most of the correspondence. Financial responsibility for the publication has, however, rested solely with the business manager.

There have been several subsequent changes in these arrangements. At the start of volume 2 Mr. Harry W. Trudell of the Philadelphia Mineralogical Society took over the business managership. At the close of this volume Mr. W. Scott Lewis, who represented the Mineral Collectors' Association, withdrew. Now, with the completion of the third volume, Mr. Levison has decided to retire. The remaining members of the board desire to express herewith, both for ourselves and on behalf of our readers, the deepest appreciation of his helpful suggestions, advice and assistance, in the development of the magazine. The former managing editor will hereafter assume the duties of editor-in-chief, and the editorial board will be increased by the appointment of seven new associate editors, as announced on the front cover page of this number.

From the outset we have never had the slightest difficulty in obtaining articles for publication; indeed, the problem has been rather to find room for everything submitted, our income having never become large enough to justify the publication of more than a limited number of pages per month. Volume 1 averaged 20 pages per number, but this proved to be more than we could afford, and we were reluctantly obliged to decrease this average to 13 in volume 2. A good-sized deficit still confronting us at the close of the latter volume,—cared for by loans from the Business Manager and the Managing Editor,—we were forced to decide between further curtailment of the size and an increase in the subscription price; and we chose the former as the lesser evil. The number of pages per ordinary number was accordingly reduced to

10, altho the year's average was raised to 17 by one special number. This has enabled us not only to pay expenses thruout the year, but even, with the assistance of friends, to reduce our deficit considerably. While at the beginning of volume 4 we will not be able to exceed this size, an increase is looked forward to in the near future, as the stabilization of world conditions brings increases in our subscription list and advertising columns.

As to subject-matter, we have endeavored to publish both popular and technical articles,—to promote mineralogy as a hobby as well as a science. A cordial invitation is extended to all of our readers to give us the benefit of their experiences in collecting and studying minerals. In our department, "Abstracts of mineralogic literature," we have made an effort to notice every article which might properly be regarded as mineralogical in character, giving especially full descriptions of all new minerals, appearing since the beginning of 1916. Articles on economic and petrologic subjects are included when they contain important new evidence bearing on problems of mineral constitution, genesis, etc. When the number of pages per number had to be diminished, we tried allotting only a page or two to these abstracts, but this soon led to our getting a year or more behind in noticing some articles, so toward the end of volume 3 we have assigned additional space to this department, and as a result it is now being rapidly brought up to date. Recent war activities have prevented or delayed our obtaining copies of many foreign publications, but we hope ultimately to include in our pages a complete account of all mineralogic work published since the beginning of 1916.

In conclusion, the undersigned desire to express their gratitude to subscribers, advertisers and friends who have so generously extended to us financial assistance and enabled us to continue publication in spite of adverse conditions in the past few years. With the beginning of volume 4 the AMERICAN MINERALOGIST may be said to have passed the experimental stage, and to be on the road to success.

E. T. W., S. G. G., H. W. T.

PROCEEDINGS OF SOCIETIES

THE PHILADELPHIA MINERALOGICAL SOCIETY

WAGNER FREE INSTITUTE OF SCIENCE, NOVEMBER 14, 1918

The Twenty-sixth Annual Meeting of the Philadelphia Mineralogical Society (postponed from October on account of the epidemic of influenza) was held on the above date with the president, Dr. Leffmann, in the chair.

The resignation of the secretary, Dr. Jones, was announced, and upon motion of the president, the former secretary, Mr. Samuel G. Gordon, was elected to the office.

Dr. Henry Leffmann presented his Presidential Address, on "The Oldest Manual of Mineralogy—Theophrastus, On Stones."

Mr. John G. Rothermel, Director of the Institute, described a trip to the Kutztown Cave, Berks Co., Pa. Mr. Gordon reported two trips to Middletown and Upper Providence, Delaware County, with negative results.

SAMUEL G. GORDON, *Secretary.*

ABSTRACTS OF MINERALOGIC LITERATURE

We print herewith a number of abstracts of articles on crystal structure, etc., which appeared during 1916–17, but have heretofore been overlooked in one way or another. Their inclusion at this late date is due to our purpose to make this department a complete record of all publications bearing upon every phase of mineralogy.

A CRITICAL TEST OF THE CRYSTALLOGRAPHIC LAW OF VALENCY VOLUMES; THE CRYSTALLINE STRUCTURE OF THE ALKALINE SULFATES. A. Ogg and F. L. Hopwood. *Phil. Mag.*, **32**, 518–525, 1916.

The distances between (100) planes, as measured by the Bragg X-ray spectrometer method, is for K_2SO_4, 5.73 x 10^{-8} cm., and the volume of the unit cell is accordingly 425 x 10^{-24} cu. cm. The corresponding volumes for Rb_2SO_4, $(NH_4)_2SO_4$ and Cs_2SO_4 are 481, 485, and 555 x 10^{-24} cu. cm. respectively. The 5 atoms of each NH_4 group, total valence 9, therefore occupy only about as much space as a single Rb atom with a valence of 1, which is evidence against the validity of the Barlow-Pope "law of valency volumes." E. T. W.

X-RAY ANALYSIS AND TOPIC AXES OF THE ALKALI SULFATES AND THEIR BEARING ON THE THEORY OF VALENCY VOLUMES. A. E. H. Tutton. *Proc. Royal Soc.*, A, **93**, 72–89, 1917.

The work described in preceding abstract is discussed, and other evidence opposed to the valency-volume theory is summarized. E. T. W.

GRATING-SPACE IN HALITE AND SYLVITE CRYSTALS AND ACCURATE DETERMINATION OF X-RAY WAVE-LENGTHS. E. Wagner. *Ann. Physik*, **49**, 625–647, 1916; thru *Chem. Abstr.*, **11**, 2303, 1917.

The probable errors in the methods of determining these factors are discussed, and the best values are concluded to be: halite, $d_{100} = 2.814$, sylvite, $d_{100} = 3.136$, both times 10^{-8} cm. E. T. W.

ROENTGENOGRAMS OF CRYSTAL TWINS. A. van der Veen. *Chem. Weekblad,* **14**, 488–491, 1917; thru *Chem. Abstr.* **11**, 2637, 1917.

The photographs obtained by the Laue method with twinned crystals are discussed. E. T. W.

INTERFERENCES IN IRREGULARLY ORIENTED PARTICLES IN ROENTGEN LIGHT. P. Debye and P. Scherrer. *Physik. Z.*, **17**, 277–283, 1916; thru *Chem. Abstr.*, **11**, 1786, 1917.

Apparently an independent development of the same method of X-ray crystal analysis worked out by Hull (see abstract in *Am. Min.*, **3**, (6), 146, 1918). The interference phenomena and the inferred structures are given for lithium fluoride, so-called amorphous silicon, and graphite. The first has the same structure as NaCl. The silicon is crystalline, and has the same structure as diamond. The graphite is trigonal and appears to have 12 atoms in the unit cell. It is possible in this way to distinguish between supposed amorphous substances which are really crypto-crystalline, and truly amorphous ones. E. T. W.

X-RAYS AND THE STRUCTURE OF CRYSTALLIZED AND AMORPHOUS CARBON. ANONYMOUS. *Engineering,* **104**, 594–596, 1917.

A summary of the work of Debye and Scherrer on this subject. Amorphous carbon appears to be identical with finely divided graphite, the unit cell of the space-lattice in both cases containing 8 atoms arranged in parallel layers at distances of 3.4×10^{-8} cm. Compare preceding abstract. E. T. W.

THE PROBABLE ATOMIC CHANGES OF BISMUTH DURING A REARRANGEMENT. A. JOHNSEN. *Centr. Min. Geol.,* **1916**, 385–392; thru *Chem. Abstr.,* **11**, 1777, 1917.

The rhombohedral crystals of bismuth are believed to contain Bi_2 groups. In solutions in other metals and in vapor form the molecule varies from Bi_2 to Bi_1. E. T. W.

THE NATURAL FREQUENCIES OF SULFATES AND CARBONATES FOR INFRA-RED RADIATION OF SHORT WAVE LENGTH. C. SCHAEFER AND M. SCHUBERT. *Ann. Physik,* **50**, 283–338, 1916; thru *Chem. Abstr.,* **11**, 913–914, 1917.

A number of minerals have been studied with infra-red rays, and it has been found possible to throw some light on their atomic structure by the spectra produced. E. T. W.

THE OPTICAL BEHAVIOR OF WATER OF HYDRATION. C. SCHAEFER AND M. SCHUBERT. *Ann. Physik,* **50**, 339–345, 1916; thru *Chem. Abstr.,* **11**, 914, 1917.

From a study of the reflection of infra-red rays by water of hydration in crystals it is shown that the water occupies positions corresponding to the symmetry, and is uniaxial or biaxial like the crystal as a whole. The location of the water molecules in the space lattices can be determined thus. E. T. W.

OPTICAL OBSERVATIONS ON QUARTZ. T. LIEBISCH. *Sitzb. kgl. preuss. Akad.,* **1916**, 870–874; thru *Chem. Abstr.,* **12**, 22, 1918.

The interference figures obtained by varying superposition of a large number of plates of right- and left-handed quartz are described. E. T. W.

CRYSTAL STRUCTURE. A. SCHÖNFLIES. *Z. Kryst. Min.,* **54**, 545–569, 1915; **55**, 321–352, 1916; thru *J. Chem. Soc.,* **112**, ii, 447, 1917.

An elaborate discussion of the bearing of Bragg's results on theories of crystal structure. The relations between point-systems and space-filling are specially considered, and it is pointed out that in a chemical compound each fundamental space unit must contain one point of each point-system present. Some of the structures worked out by Bragg could have been predicted on this basis. E. T. W.

DIFFERENTIATION OF THE INTERNAL STRUCTURE OF THE DIFFERENT SPECIES OF SILICA BY THEIR ROENTGEN-RAY INTERFERENCE PATTERNS. S. KYROPOULOS. *Z. anorg. allgem. Chem.,* **99**, 197–200, 1917; thru *J. Chem. Soc.,* **112**, ii, 468.

The various forms of silica were powdered and studied by the Debye-Scherrer method (abstract above). The patterns from quartz and cristobalite are readily distinguishable, quartz glass and pptd. silica give no rings, silica gel a single broad ring. After heating silica gel to 1300° rings appear, showing partial conversion to cristobalite. E. T. W.

PLATE 2.

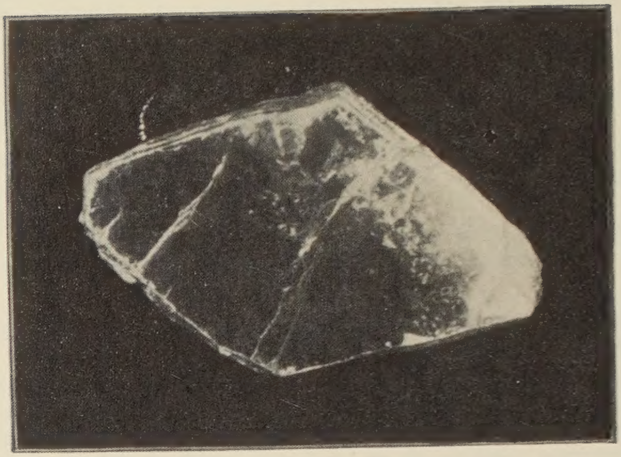

Fig. 1. Muscovite. $\frac{1}{3}$ Size.

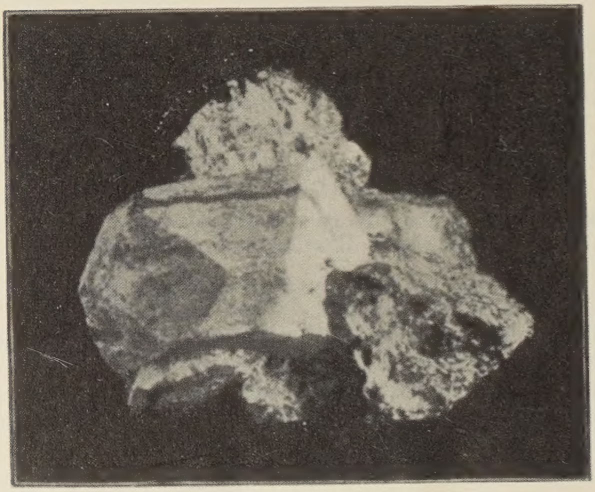

Fig. 2. Oligoclase. $\frac{1}{2}$ Size.

New York City Minerals.

From "The Minerals of Broadway," by James G. Manchester (Bull. 3, New York Mineralogical Club.)